KROHN-HITE CORPORATION

PRELIMINARY MANUAL

MODEL LDS-1500

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MODEL LDS-1500

FINAL OPERATING AND MAINTENANCE MANUAL
WILL BE FORWARDED WHEN PRINTED

KROHN-HITE CORPORATION
580 Massachusetts Avenue, Cambridge, Mass., U.S.A.

2. DESCRIPTION

The Model LDS-1500 was designed for use in Standards Laboratories to supply adequate power for calibration, by the comparison method, of all ac voltmeters and ammeters normally used for laboratory measurements. This instrument is also extremely useful as a general purpose Variable Frequency Power Source. The exceptionally low harmonic distortion of the output voltages and currents from this instrument permits accurate calibration of meters which are sensitive to harmonic frequencies. Exceptionally good short term amplitude stability, also essential for accurate meter calibration, is achieved by a new and exclusive Krohn-Hite oscillator circuit development. 40 watts of power are available over the frequency range from 20 cps to 20 kc with less than 0.25% total harmonic distortion, typically 0.1% at 50 watts over most of this frequency range.

SECTION II - OPERATION

The Model LDS-1500 is shipped completely assembled. Before operating, the cable connections in the rear should be checked to insure that none has been jarred loose during shipment. The line cords from the Amplifier, Model LDS-102R, and the Oscillator, Model LDS-443R, should be connected to the power outlets at the rear of the Control Unit, Model LDS-501R, to allow the Model LDS-1500 to be turned on by the POWER switch on the front panel of the Control Unit. At the rear of the Amplifier, which is the top instrument, there is a HIGH-LOW line switch that should be set to the LOW position if the line voltage is between 105 and 114. For a line voltage between 114 and 125 this switch should be in the HIGH position.

Before connecting the line cord of the Control Unit to the power line, the POWER ON-OFF switch should be in the OFF position.

1. After connecting the line cord to the power line, the COARSE AMPLITUDE CONTROL should be set to the maximum ccw position before switching the power ON. Switch the power on and wait one minute before advancing the AMPLITUDE CONTROLS. This interval allows time-delay relays in the Amplifier and Control Unit to operate.

The Model LDS-1500 Power Source can be used immediately. However a 30 minute warm up time is recommended to obtain optimum amplitude stability.

2. After adequate warm up time the load may be connected.

3. Obtain the desired operating frequency by proper setting of the FREQUENCY MULTIPLIER switch, all three banks of FREQUENCY-CPS pushbuttons and the frequency VERNIER control.

All units except the Oscillator are designed to operate in the 20-20,000 cps frequency range only. Operating outside of this range will result in degraded performance.

4. Set the FREQUENCY RANGE switch to include the operating frequency.

5. For proper load impedance matching, the OUTPUT RANGE switch should be set to the lowest range which includes the voltage desired.

6. Advance the AMPLITUDE CONTROLS to the voltage desired. Do not exceed rated output as indicated by the PERCENT OUTPUT meter. Excessive output will overload the Amplifier and release the circuit breaker.

CAUTION: It is expecially important to return the COARSE AMPLITUDE CONTROL to the maximum ccw position before operating any switches.

TEST JACK VOLTAGES

Adjustments have been made at the Factory to set the voltage on each of the two test jacks, TP 1 and TP 2, located on the front panel of the Amplifier. Before extensive use of the Model LDS-1500 it is recommended that these voltages be checked. Due to feedback circuit design in the Amplifier, gradual deterioration of tubes or components will ordinarily not be detected until complete failure occurs. For this reason it is suggested that a periodic check and readjustment of the output tube plate currents be made after every 500 hours of use in order to maintain lowest distortion operation. These plate currents can be checked by measuring the dc voltage between the chassis and test jacks, TP 1 and TP 2 in the following manner:

The adjustments should be made with the Model LDS-1500 warmed up for at least 30 minutes. The COARSE AMPLITUDE CONTROL on the Control Unit should be set to the maximum ccw position.

With the voltmeter connected between the two test jacks, the front panel screwdriver adjustment marked BALANCE should be turned until the reading is zero, indicating balance of plate currents. A clockwise turn of this adjustment will make the voltage at TP 1 go more positive. The response of the voltmeter to this adjustment is very slow (the time constant is about 10 seconds) because the full feedback of the Amplifier is opposing. Making this adjustment in several small steps and observing the effect of each, might be easier than trying to turn the pot slowly enough for the voltmeter to follow.

When both test points have stabilized at the same voltage, the voltmeter should be connected between one test point and chassis (black binding post on the Control Unit can be used) and the reading adjusted to between .95 and 1 volt with the front panel screwdriver adjustment labeled BIAS. This is a much faster adjustment than the BALANCE.

If the adjustments required in either of these steps have been considerable, a small interaction between the BALANCE and BIAS adjustments may be present and the previous procedure should be repeated.

FUSING

The Amplifier and Oscillator are individually fused. Also the complete LDS-1500 is fused with a 6 1/4 Ampere SLOW blow fuse on the panel of the Control Unit. In the event that the main fuse blows the pilot light on both the Amplifier and Oscillator will go out. If either one of the other fuses blow the corresponding instrument pilot light will go out.

SECTION III - REMOVAL OF INSTRUMENTS FROM THE RACK

The Amplifier may be taken out of the rack by removing the four panel screws in front and the two screws in the rear holding the small bracket to the slide rail. The two screws fastening the small bracket to the Amplifier should not be removed as these hold the bottom plate to the chassis.

The Oscillator may be taken out by removing the four front panel screws and the two screws in the rear which secure the instrument to the slide rails.

Removal of the Control Unit is achieved by removing the eight front panel screws. In earlier models, Serial Nos. 104 - 108 of the LDS-1500, the third screw from the bottom on both sides is fastened by a nut and lockwashers. After the front panel screws have been removed, the screws holding the side braces which are inside of the rack should be taken out. There are three screws on each side brace one toward the front and two on the rear.

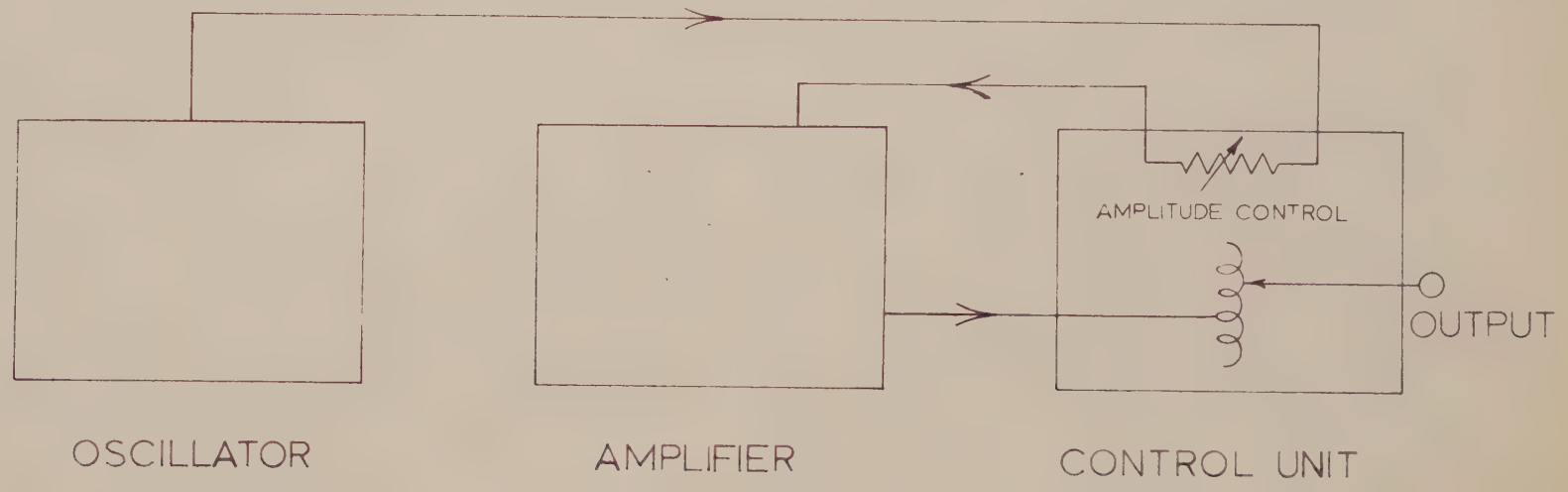
NOTE: The transformers may produce an audible tone when operating at high levels. This is normal and should not be interpreted as a symptom of failure.

The Model LDS-443R and Model LDS-102R are modified versions of the standard Model 440-A push-botton oscillator and the Model UF-101A ultra-low distortion power amplifier. Accordingly the Operating and Maintenance Manuals of both these instruments are enclosed since they can be used for the major portion of the maintenance problems.

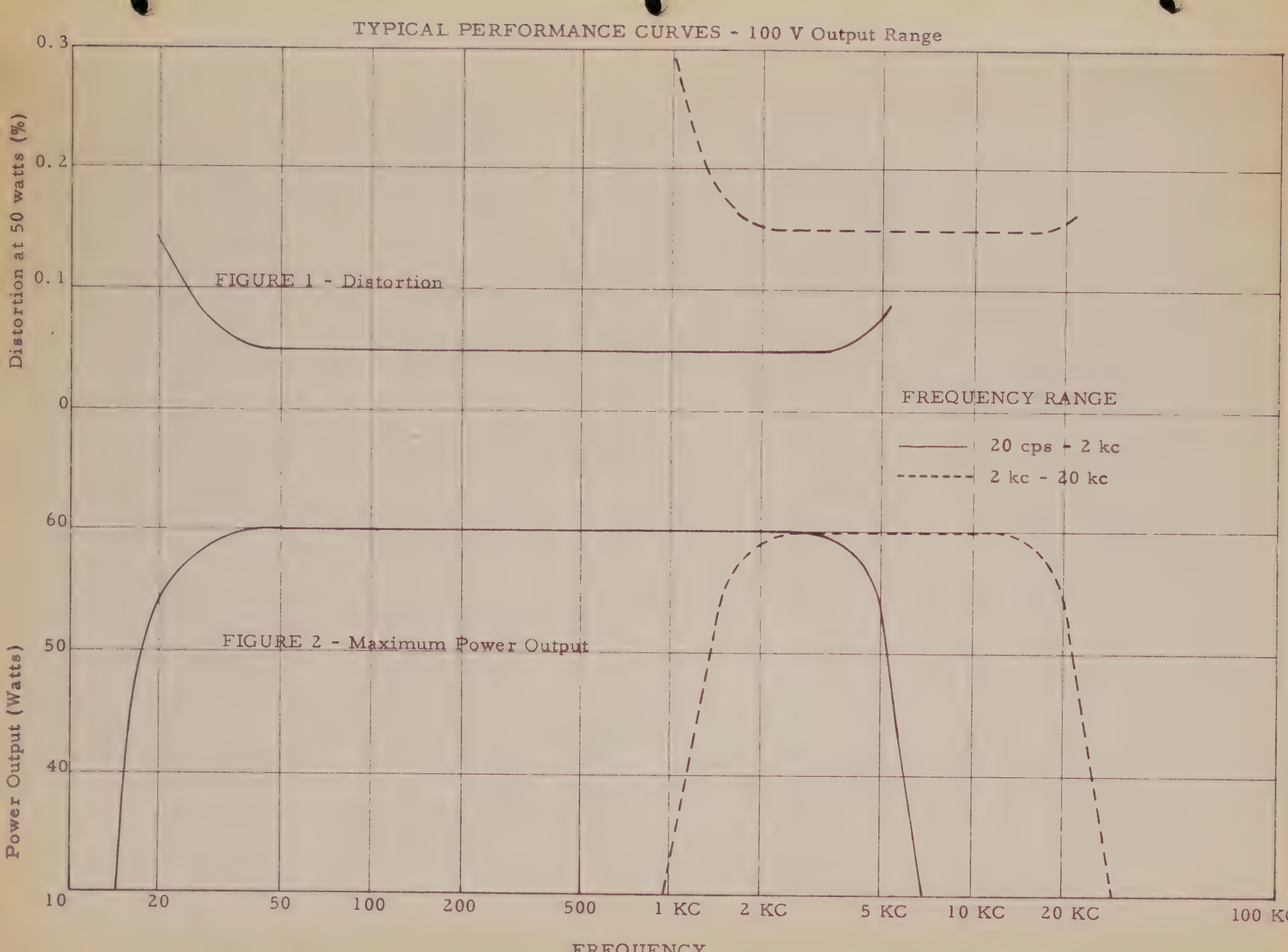
The Model LDS-443R differs from the Model 440 in that the RMS VOLTS control, the front panel OUTPUT terminals, the .01 position of the FREQUENCY MULTIPLIER switch and the POWER ON-OFF switch have been removed. In addition, the AVC circuit has been modified extensively and a constant temperature oven has been incorporated to house the critical components. The square wave circuitry has also been removed.

The Model LDS-102R is similar to the Model UF-101A except that all of the front panel controls and terminals have been removed and the feed-back circuits have been modified to allow remote operation.

09/92/6



BLOCK DIAGRAM


TYPICAL PERFORMANCE CURVES - 100 V Output Range
Distortion at 50 watts (%)
0.3
0.2
0.1
0
FIGURE 1 - Distortion
FREQUENCY RANGE
20 cps - 2 kc
2 kc - 20 kc
60
50
40
10
Power Output (Watts)
FIGURE 2 - Maximum Power Output
20
50
100
200
500
1 KC
2 KC
5 KC
10 KC
20 KC
100 K
FREQUENCY

KROHN-HITE CORPORATION

SPECIAL SPARE PARTS LISTS

This Spare Parts List is published only for the information and guidance of users of this equipment. The Krohn-Hite Corporation does not assume any responsibility by publishing this List and does not imply that the parts shown are necessarily considered subject to excessive failure or that these are the only parts which may fail.

The items listed are those which are made or modified especially for this instrument and are not obtainable at electronic supply houses, or are standard parts which may be difficult to obtain at regular supply houses. All electron tubes are to be considered subject to failure, and this List does not show readily available receiving types.

In making up a set of spare parts for field use it is suggested that the inclusion of parts other than those which are only available from the factory be governed by the availability of the parts from local sources. Quantities of individual parts to be included depends on length of service required and many other factors which can only be assessed by the user.

1. ALL PRICES F.O.B. CAMBRIDGE, MASSACHUSETTS

2. STOCK DELIVERY ON MOST ITEMS IN REASONABLE QUANTITIES

KROHN-HITE CORPORATION

MODEL LDS-102

SPECIAL SPARE PARTS LIST

SYMBOL	DESCRIPTION	QUAN.	PART. NO.	UNIT PRICE
C-103	Mica 100 uuf 1000 V 10%	1	CM19C101K	$ .25
C-114	Electrolytic 60-40 uf 500V 10%	6	C19253	6.90
C-138	2 uf ±10% 200 WVDC	1	MTM-103	2.75
C-202	Oil-Can 4 uf 330 VAC	4	P104J	4.25
C-203	Mica 51 uuf 1000V 10%	1	CM19C510K	.25
C-204	Mica 150 uuf 500V 5%	1	CM19C151J	..25
C-301	Oil-Can 1000-1000 uf 25 VDC	1	D19874	2.44
D-301	Selenium Rectifiers 75 MA 160V	1	#1007	3.34
D-302	Selenium Rectifiers 600 MA 25V	1	#1017	2.48
	Pilot Lite	1	#51	.20
	Circuit Breaker	1	8111	12.50
K-102	Time delay relay (Agastat)	1	NE-11	35.00
L-201	Choke	2	8.2uH	.50
L-202	Choke	2	36 uH	.50
L-205	100 microhenry	1	6174-6	1.75
L-206	22 millihenry	1	2281	1.75
L-207	10 millihenry	1	3500-42	1.75
L-301	Hum Buck Choke	1	C-100-1	11.90
L-302	Choke	1	C-100-2	5.00
R-107	820 ohm ±1% 1/2W Evanohm	1	R615	1.00
R-125	Wire wound 10K 5W 5%	1		1.00
R-138	Wire wound 40K 10W 5%	1		1.50
R-140	470 ohms ±1% 1/2W Evanohm	1	R615	1.00
R-205	Deposited Carbon 5.5M 1W ±1%	1	C-13	.60
R-237, R-238	7 ohms ±1% 1/2W Evanohm	2	R615	1.00

SYMBOL	DESCRIPTION	QUAN.	PART NO.	UNIT PRICE
R-301	Wire Wound 20 ohm 3W 5%	1		$ .50
R-302	Wire Wound 17.5K 10W 5%	1		1.00
R-308	Wire Wound 30K 10W 5%	4		1.00
R-312	Wire Wound 1.1 ohm 5W 5%	1		.75
RT-101	10K ±30% at 5VDC	1		2.50
T-201	Output Transformer	1	P-100-1	38.80
T-301	Power Transformer	1	P-100-4	31.00
V-5	Tubes 6550	4		5.50

1. ALL PRICES F.O.B. CAMBRIDGE, MASSACHUSETTS
2. STOCK DELIVERY ON MOST ITEMS IN REASONABLE QUANTITIES

KROHN-HITE CORPORATION

MODEL LDS-443

SPECIAL SPARE PARTS LIST

SYMBOL	DESCRIPTION	QUAN.	PART NO.	UNIT PRICE
C-312, C-313	1 uf 1%	2	MF111	$3.25
C-401	4 uf 330 VAC +20%	2	P104J2	4.25
L-401	8 HY at 150 MA	1	C-100-8	4.00
P-301	10 meg. Dual Clocklog pot	1	JJ33487	22.50
R-103	22K 1/2W 2%	1	C-12	.75
R-123	9.1K 55W 10% CT	1	55S 3-1/2" Stripohm #235 Term. Type 816 Mtg.	3.75
R-221	Wire wound 4K 20W 5%	1	LOW Axiohm	1.25
	Resistor, deposited carbon, ±1%			
R-301	5.423Meg	1	-	1.50
R-302	5.036 Meg	2	-	1.50
R-304	2.611 Meg	1	-	1.50
R-305	2.518 Meg	2		1.50
R-307	1.72 Meg	1		1.00
R-308	1.679 Meg	2		1.00
R-311	542.3K	1		1.00
R-312	503.6K	5		1.00
R-314	261.1K	1		1.00
R-315	251.8K	5		1.00
R-317	172K	1		1.00
R-318	167.9K	5		1.00
R-331	50.36K	6		1.00
R-334	25.18K	6		1.00
R-337	16.79K	6		1.00
R-351	5.030K	3		1.00
R-354	2.512K	3		1.00
R-357	1.671K	3		1.00

SYMBOL	DESCRIPTION	QUAN.	PART NO.	UNIT PRICE
	Resistor, Evanohm wire-wound, ±1%			
R-410	155K 1%	1		$3.25
R-413	150K 1%	1		3.25
S-301	Switch-10 gang push button without resistors	3	D-110	37.50
S-302	Same as S301			
S-303	Same as S301			
	Switch S301, S302 or S303 completely assembled with resistors and condensers			72.50
S-304	Frequency Multiplier switch		PA241-040 (Mod.)	7.00
	Switch S304, complete with components C308, C309, C309A, C310, C311, C315, C316 and R361, R362			37.50
T-401	Primary 115V-50-60 CPS Secondary	1	P-100-32	14.50
Z-101	Oven Assembly, complete			125.00
	Resistor, metal film, ±1%, IRC			
R-204	1.5 Meg	1	MECT-0	2.25
R-208	1.05 Meg	1	MECT-0	2.25
R-215	56K	1	MECT-0	2.00
R-216	120K	1	MECT-0	2.00
	Resistor, Evanohm wire-wound, ±1%			
R-102	600 ohm	1	R615	1.00
R-104	5.3K	1	R615	1.00
R-111	77K	1	RS7	2.25
R-112	2.1K	1	R615	1.00
R-119	12K	1	RS2B	1.50
R-121	1.25K	1	R615	1.00
R-133	17.5K	1	RS2B	1.75
	Resistor, Power, wire-wound			
R-420	4.5K ±5% 30 watt		Stack mtg	2.75

KROHN-HITE CORPORATION

CONTROL UNIT

MODEL LDS-501

SPECIAL SPARE PARTS LIST

SYMBOL	DESCRIPTION	QUAN.	PART NO.	UNIT PRICE
K-101	Time delay relay (Agastat)	1	NE-12	$35.00
L-201	Choke 5 mh	1	3500-40	1.75
R-101	Wire Wound 20 ohm 5W 5%	1		.75
R-102	Wire Wound 1.1 ohm 5W 5%	1		.75
	Resistor, Evanohm wire-wound, ±1%			
R-200	1.25K	1		1.00
R-201	180 ohm	1	R615	1.00
R-202	168 ohm	1		1.00
R-203	150 ohm	1		1.00
R-204	135 ohm	1		1.00
R-205	125 ohm	1		1.00
R-206	112 ohm	1		1.00
R-207	102 ohm	1		1.00
R-208	93 ohm	1		1.00
R-209	86 ohm	1		1.00
R-210	77 ohm	1		1.00
R-211	70 ohm	1		1.00
R-212	65 ohm	1		1.00
R-213	58 ohm	1		1.00
R-214	53 ohm	1		1.00
R-215	48 ohm	1		1.00
R-216	44 ohm	1		1.00
R-217	40 ohm	1		1.00
R-218	36 ohm	1		1.00
R-219	32 ohm	1		1.00
R-220	30 ohm	1		1.00
R-221	27 ohm	1		1.00
R-222	109 ohm	1		1.00
R-223	108 ohm	1		1.00
R-224	34 ohm	1		1.00
R-225	680 ohm	1		1.00
R-228	Control-Fine, 2000 ohm	1	HD150	15.00
R-229	Control-Vernier 100K	1	JU1041	1.75

KROHN-HITE CORPORATION SPECIAL SPARE PARTS LIST - CONTROL UNIT
MODEL LDS-501

SYMBOL	DESCRIPTION	QUAN.	PART NO.	UNIT PRICE
R-230	Resistor, Evanohm wire-wound, ±1% 18 ohm	1		$1.00
S-102	Switch, Voltage and Current 4 pole 2 position	1	60093	45.00
S-103	Switch, Frequency 2 pole, 11 position	1	60074A	65.00
S-201	Switch, Control 2 pole, 24 position, shorting	1	8640	15.00
T-101	Transformer-Low Frequency 20 cps 2KC	1	NES-1727	300.00
T-102	Transformer-High Frequency	1	NES-1487	200.00

1. ALL PRICES F.O.B. CAMBRIDGE, MASSACHUSETTS
2. STOCK DELIVERY ON MOST ITEMS IN REASONABLE QUANTITIES

All voltage and resistance values measured from the pins of each socket to ground (chassis).

Voltages measured with instrument operating from a 119 volt 60 cps source and line voltage switch in HIGH position. DC voltages measured with a VTVM having an input resistance of 11 megohms.

NOTE: All resistance values in OHMS. K = 1,000 M - 1,000,000

Resistance measured from L302 to ground (chassis) is 17K.
Resistance measured across C306B is 60K when the positive (+) ohmmeter lead is connected to ground (chassis).

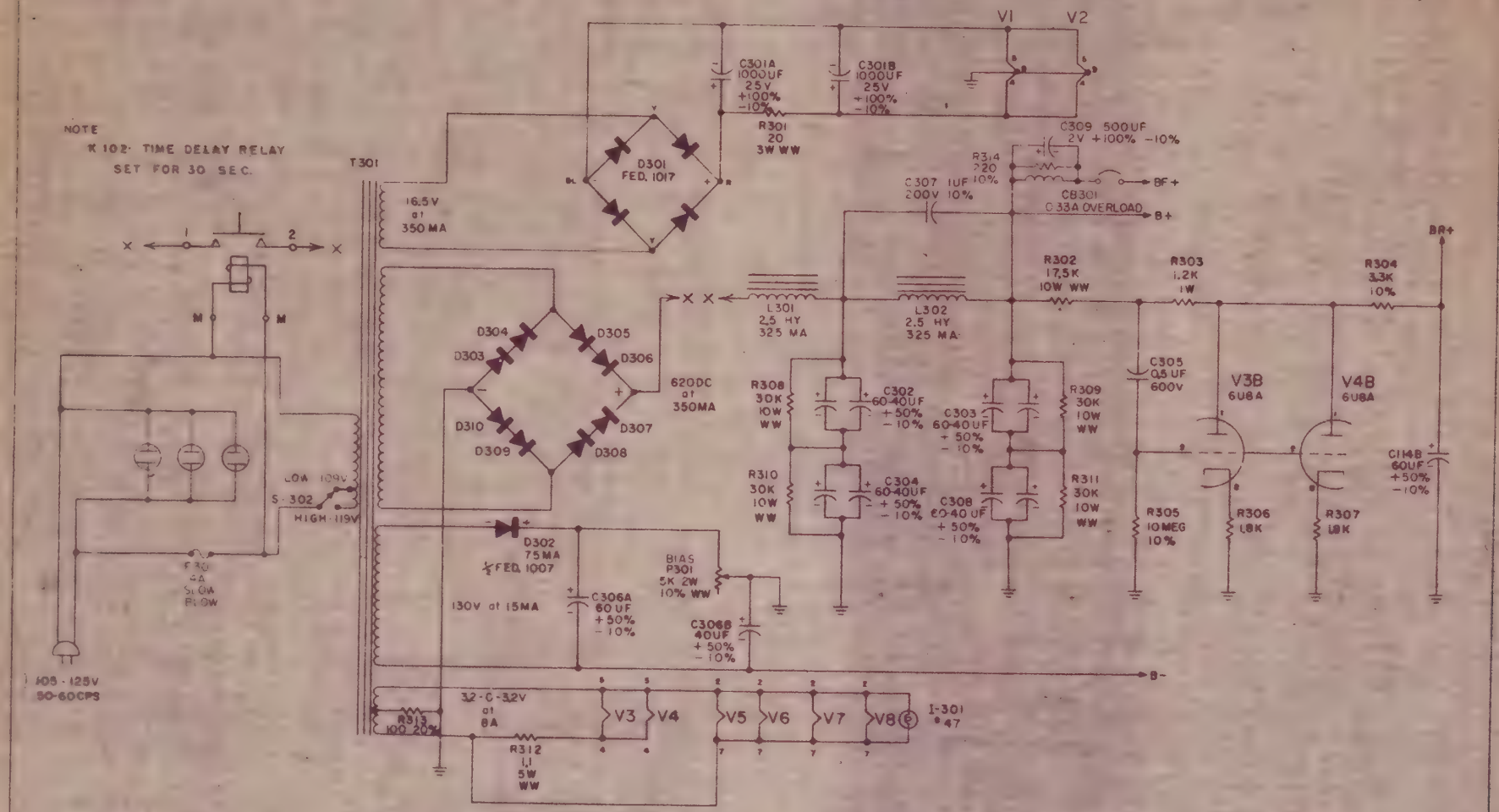
Variations of up to ±20% in all readings can be expected.

Tube No.	Tube Type		PIN NUMBER								
			1	2	3	4	5	6	7	8	9
V1	12AX7	V	160	0	1.1	6.8	-7.0	160	0	1.1	0
		R	110K	7M	300	5	5	110K	7M	300	0
V2	12AX7	V	160	0	1.2	6.8	-7.0	160	0	1.2	0
		R	110K	660K	330	5	5	110K	660K	330	0
V3	6U8A	V	310	0	295	2.0ac	3.0ac	305	29	10	0
		R	27K	25M	32K	90	90	65K	50K	2.2K	10M
V4	6U8A	V	310	0	295	2.0ac	3.0ac	310	29	8.5	0
		R	27K	25M	32K	90	90	65K	50K	2.2K	10M
V5	6550	V	0	3.0ac	615	605	-15	--	3.0ac	45	--
		R	0	90	18K	19K	200K	--	90	675	--
V6	6550	V	0	3.0ac	615	605	-15	--	3.0ac	45	--
		R	0	90	18K	19K	200K	--	90	675	--
V7	6550	V	0	3.0ac	615	605	-15	--	3.0ac	45	--
		R	0	90	18K	19K	200K	--	90	675	--
V8	6550	V	0	3.0ac	615	605	-15	--	3.0ac	45	--
		R	0	90	18K	19K	200K	--	90	675	--

Model LDS-102R - TABLE OF VOLTAGE AND RESISTANCE MEASUREMENTS

Sense leads, Pins 1 and 2 on J102, Serial Nos. 104 to 112, should be connected to output (1 to hot side and 2 to ground).

On Serial Nos. 113 and above the black lead connected to the hot side and the white lead to ground.



NOTES

(1) RESISTANCES IN OHMS, K=1000, MEG=1000000.

(2) RESISTORS ±5% ½ WATT UNLESS OTHERWISE SPECIFIED.

(3) CAPACITANCES IN UUF UNLESS OTHERWISE SPECIFIED.

(4) CAPACITORS ±20% 500 WVDC UNLESS OTHERWISE SPECIFIED.

(5) S-301 SHOWN IN OFF POSITION.

(6) D303 TO D310 ARE RATED 600 PIV — 500MA PER UNIT

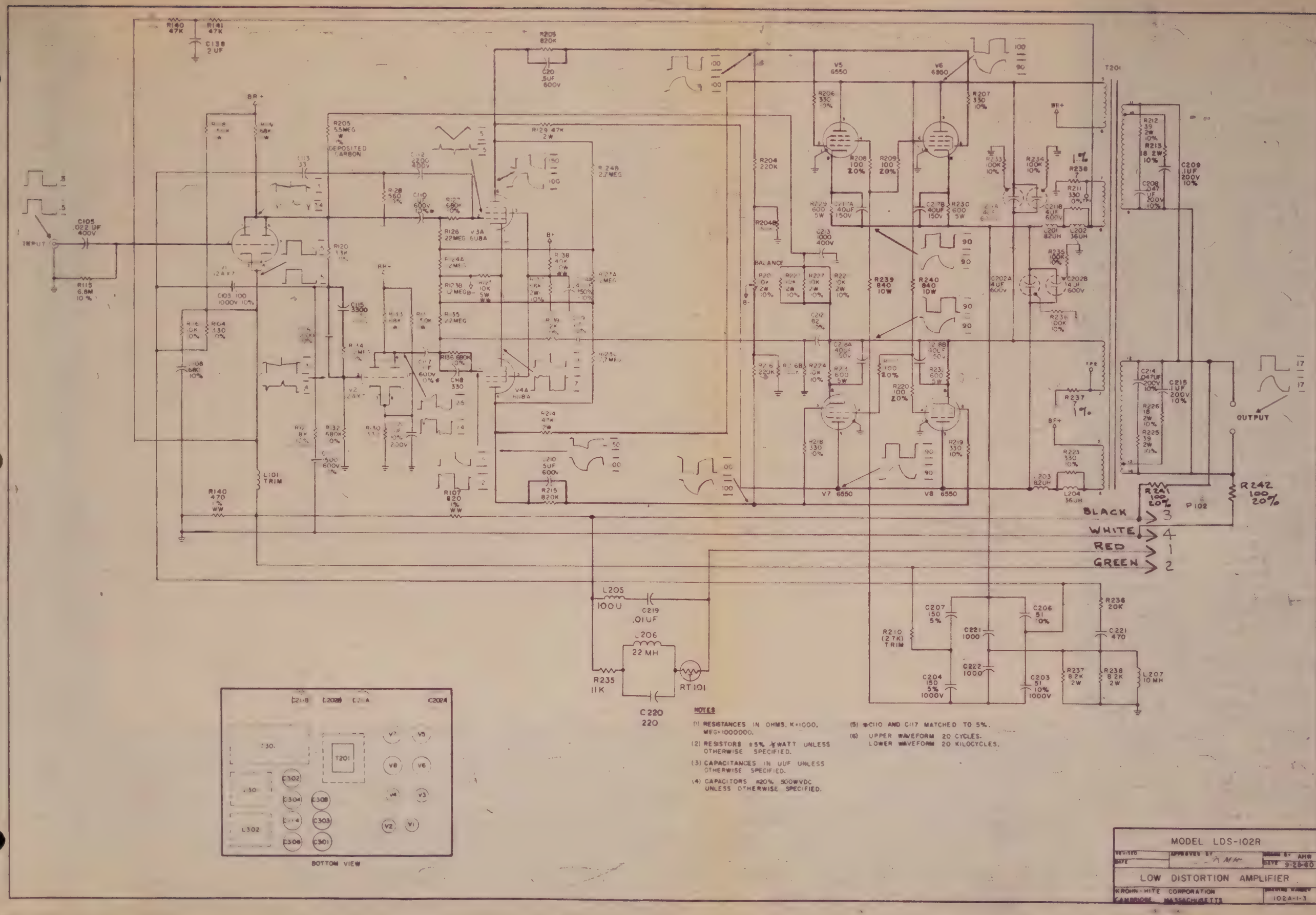
MODEL LDS-102 R

REVISED 1-8-60		DRAWN BY AHW
DATE 4-4-59		APPROVED BY

POWER SUPPLY

KROHN-HITE CORPORATION
CAMBRIDGE, MASSACHUSETTS

DRAWING NUMBER LDS-102-R



BOTTOM VIEW

NOTES

(1) RESISTANCES IN OHMS, K=1000, MEG=1000000.

(2) RESISTORS ±5% ½WATT UNLESS OTHERWISE SPECIFIED.

(3) CAPACITANCES IN UUF UNLESS OTHERWISE SPECIFIED.

(4) CAPACITORS ±20% 500WVDC UNLESS OTHERWISE SPECIFIED.

(5) *C110 AND C117 MATCHED TO 5%.

(6) UPPER WAVEFORM 20 CYCLES. LOWER WAVEFORM 20 KILOCYCLES.

MODEL LDS-102R

REVISED	APPROVED BY	DRAWN BY AMH
DATE		DATE 9-28-60

LOW DISTORTION AMPLIFIER

KROHN-HITE CORPORATION
CAMBRIDGE, MASSACHUSETTS

DRAWING NUMBER 102A-1-3

RESISTANCE MEASUREMENTS OF OUTPUT TERMINALS

CONTROL UNIT

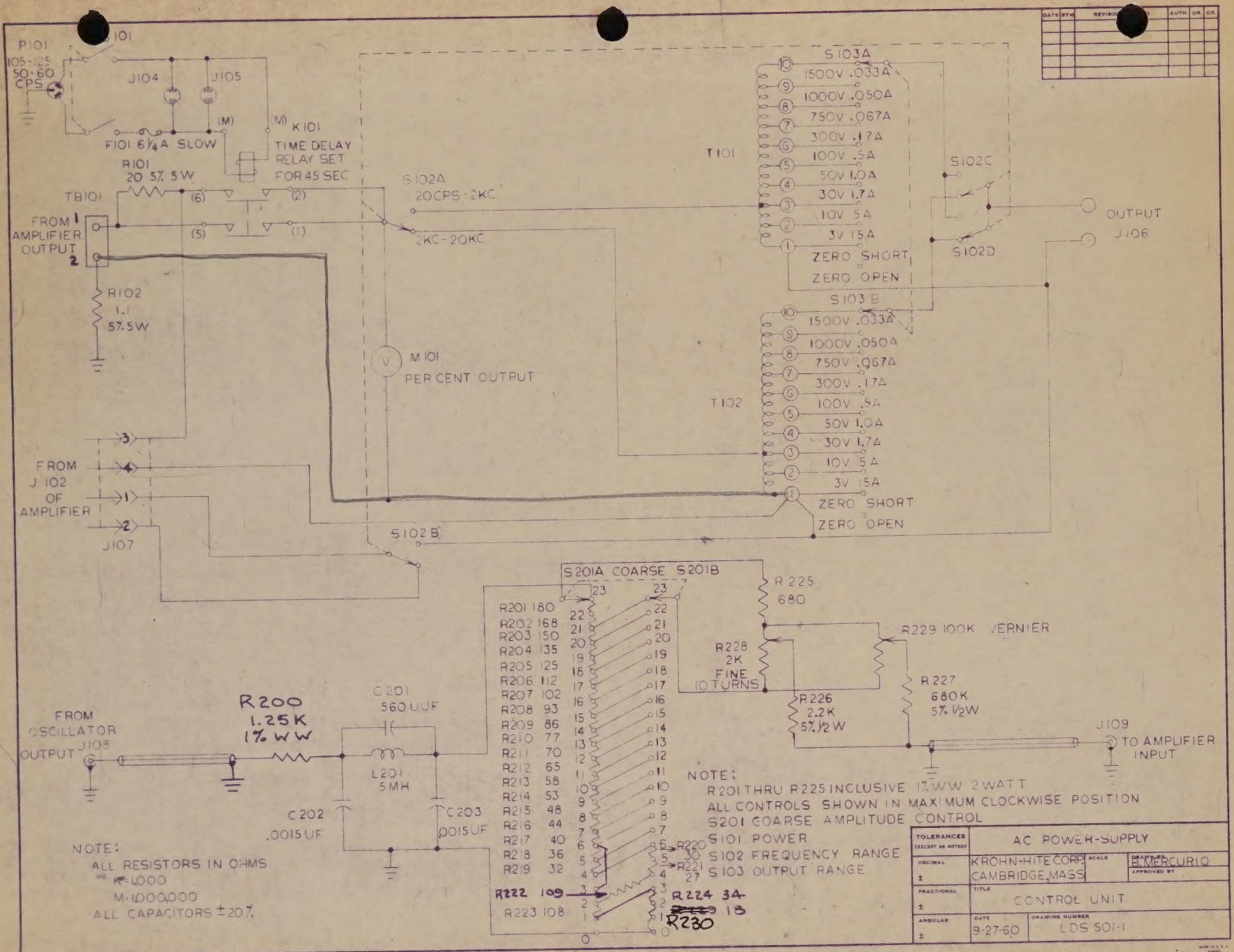
MODEL LDS-501

OUTPUT RANGE	FREQUENCY RANGE	
	20 cps-2 kc	2 kc-20 kc
Zero open	∞	∞
Zero short	.012	.012
3V	.032	.011
10V	.076	.012
30V	.772	.060
50V	1.49	.103
100V	4.44	.207
300V	66.7	3.86
750V	221	17.3
1000V	274	25.2
1500V	395	36.5

All resistances in ohms.

Resistances measured with Leeds and Northrup Resistance Bridge, Model 5305.

Resistances measured directly across the output terminals.



NOTE:
ALL RESISTORS IN OHMS
K = 1,000
M = 1,000,000
ALL CAPACITORS ±20%

NOTE:
R201 THRU R225 INCLUSIVE 1% WW 2 WATT
ALL CONTROLS SHOWN IN MAXIMUM CLOCKWISE POSITION
S201 COARSE AMPLITUDE CONTROL
S101 POWER
S102 FREQUENCY RANGE
S103 OUTPUT RANGE

TOLERANCES (EXCEPT AS NOTED)	AC POWER-SUPPLY		
DECIMAL ±	KROHN-HITE CORP. CAMBRIDGE, MASS.	SCALE	DRAWN BY B. MERCURIO
FRACTIONAL ±	TITLE CONTROL UNIT		APPROVED BY
ANGULAR ±	DATE 9-27-60	DRAWING NUMBER LDS 501-1	

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